Racial Disparity in Surgical Complications in New York State

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Objective: To examine the relationship between race and surgical complications.

Summary Background Data: Blacks have been reported to experience higher rates of surgical complications than whites, but the reasons are not known.

Methods: The effect of the black race on risk of any surgical complication (from the Agency for Healthcare Research and Quality's patient safety indicators) was examined using New York State (NYS) hospital discharge data from 1998 to 2000. Sequential, hierarchical analyses controlled for: 1) patient age and gender, 2) morbidity length of stay, 3) individual social factors, 4) hospital characteristics, and 5) ecologic factors (region of state, percent black and Medicaid annual discharges, and mean income of admitted patients).

Results: Following adjustment for patient age and gender, blacks had 65% higher odds for a surgical complication. Further adjustment for comorbidity and length of stay (LOS) reduced the odds substantially to 1.18. Additional adjustment for American Hospital Association hospital characteristics essentially eliminated the risk. Final adjustment for hospital ecologic variables reduced the odds to 1.0.

Conclusions: Higher rates of surgical complications among blacks than whites in NYS are primarily explained by differences in comorbidity LOS and the hospital where the surgery occurred.

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Despite extensive documentation of racial/ethnic disparities in medical care and use of surgical procedures,[1] less attention has been given to racial disparities in surgical complications. Blacks have been reported to have higher rates of mortality[2,3]and have higher rates of readmission,[4] following coronary bypass surgery than whites. They have also been reported to experience more complications than whites following hip replacement surgery,[5] vascular surgery,[6] glaucoma surgery,[7] and endarterectomy.[8] Other studies have reported comparable outcomes by race, particularly in the Veterans Administration Health system.[9,10] Apparent racial disparities in complications and outcomes may represent publication bias, confounding by unmeasured differences in patient morbidity or disease severity,[11–15] or result from greater use of low-volume hospitals[16]or lower-quality surgeons.[17]

Last year, the Agency for Health Care Research and Quality (AHRQ) released the first National Healthcare Disparity Report (NHDR). Based on hospital discharge data from States across the country where race data are collected, the report showed that blacks experience higher rates of various postoperative complications and injuries after adjustment for age, sex, age-sex interaction, and APR-DRG than whites.[18]

We sought to explore these NHDR findings in more detail using the New York State (NYS) Inpatient Data Set. We conducted analyses that sequentially controlled for individual patient characteristics, patient comorbidity length of stay (LOS), and hospital characteristics. We chose NYS data because hospitals in these state report diagnoses present upon admission, allowing morbidity preceding hospitalization to be distinguished from hospital-related morbidity.

MATERIALS AND METHODS

Data Source and Population

Data were derived from the NYS State Inpatient Data Set 1998 to 2000. The study population included adult patients hospitalized for acute care in NYS. The following patients were excluded from analysis: patients younger than 18 years or older than 100 years; patients with missing or miscoded hospital identifiers, patients transferred from law enforcement facilities (jails and prisons), other hospitals or long-term care facilities; maternity patients; and patients discharged from hospitals that were not open for all 3 years of the study.

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Outcome Variable

To maximize power, we created a variable indicating the presence of any of the postoperative complications identified in the AHRQ's list of postoperative patient safety indicators[19]: hemorrhage or hematoma, pulmonary embolus or deep vein thrombosis, physiologic/metabolic derangement, respiratory failure, septicemia, or abdominal wound dehiscence. The variable was coded as 1 if at least one of the complications was present and 0 if the patient was at risk for at least one of the complications, but none was recorded. We also examined each of these outcomes separately.

Key Independent Variable

Patient race coded upon hospital admission (black versus white). Patients of other races and Hispanics were excluded from these analyses.

Covariates

Patient Characteristics

Age (years), gender, type (elective or not), LOS (days), comorbidity (all diagnoses present on admission), insurance (private, Medicaid, Medicare, or self-pay), HMO status (yes/no), and patient zip code-derived median income.

Hospital Characteristics

Hospital size (number of beds), ownership (for-profit/other), academic affiliation (teaching hospital or not), full-time equivalent registered nurses (RNs), and full-time equivalent Licensed Practical Nurses (LPNs) from the Hospital Association file were merged with the discharge data. We also developed additional hospital-level measures. We developed a measure for the average daily census based on discharges during the year and used this to assess nursing staffing (RNs/ADCs and LPNs/ADC). We also created a case-mix-adjusted measure of nursing workload, by regressing the nurses to bed day ratios onto the patient age, gender, and morbidity on patient level analyses across the whole dataset. The mean residual for each hospital was taken to be a measure of case-mix-adjusted nursing deficit for the hospital. Hospital specialization was measured using the Herfindahl index (sum of squared shares of the 25 Major Diagnostic Category groupings of DRG-18 diagnosis codes.). Such indices have been previously used to measure physician specialization.[20,21] A high index indicates concentration of discharge diagnoses in one area. A low index indicates a greater range and distribution of diagnoses. Sixteen of 214 (7.5%) hospitals with indices over 0.20 were excluded. These hospitals accounted for only 2.3% of all discharges statewide during the study period.

Hospital Ecologic Characteristics

The following hospital-level variables were derived from discharge and census data: percent black patients discharged in the past year (in quartiles for all black patients), percent Medicaid patients discharged (in quartiles for all hospital patients), and Metropolitan Statistical Area size (MSA, MSA size greater than or equal to 2.5 million persons).

Statistical Analyses

All analyses were conducted at the patient level, accounting for the nesting of patients within hospital (using STATA, version 8.1, STATA CORP, College Station, TX). We used a series of hierarchical logistic regression models to sequentially control for patient and hospital characteristics. The first model included, in addition to race, patient age, age squared, and gender. The second model added biomedical characteristics (the presence or absence of a series of comorbidities and LOS). The comorbidities were derived from a list generated by AHRQ for comorbidity adjustment.[22] The third model added patient social and economic factors, including insurance, HMO status, and admission type (elective or not). The fourth model added hospital characteristics from the American Hospital Association file. The final set of models added hospital ecological characteristics, individually and together.

RESULTS

The sample contained 145,833 blacks and 865,293 whites. Patient characteristics and the unadjusted rates of surgical complications are shown in Table 1. Compared with whites, blacks had higher overall complications, particularly thromboembolism and septicemia. Blacks were significantly younger and more likely to be female. They had greater morbidity (longer LOS, and more conditions). Blacks resided in zip codes with lower median incomes and had less favorable insurance (more self-pay and Medicaid). They had fewer nonemergent admissions and were more often admitted to larger, teaching hospitals located in a large MSA. They were more likely to be admitted to hospitals located in zip codes with lower median income or that served more patients who were black or who had Medicaid.

Table 2 shows the key findings from each of the models. Following adjustment for patient age and gender, blacks had a 65% higher odds for a surgical complication. This elevated risk held across most of the categories of complications. Following adjustment for comorbidity and LOS, the odds were reduced substantially to 1.18. Additional adjustment for American Hospital Association hospital characteristics essentially eliminated the risk. Further adjustment for hospital ecologic variables reduced the odds to 1.0. Similar results were found when separate analyses were conducted for each of the postoperative complications. In no instance did race remain significant in the fully adjusted model.

TABLE 1. Patient and Hospital Characteristics by Race

	Black		White	
Variable	***N***	**%/Mean (SD)**	***N***	**%/Mean (SD)**
Outcomes				
Any postoperative complication*	145833	1.8	865293	1.4*
Hemorrhage/hematoma	145577	0.2	864057	0.2
Physiologic derangement	59754	0.1	473005	0.1
Respiratory failure	52335	0.2	396919	0.2
Thromboembolism	144524	1.4	859523	1.0*
Septicemia	20095	0.7	135149	0.5*
Wound dehiscence	40547	0.2	217288	0.3
Patient demographics				
Age		53.5 (17.53)		61.5* (17.6)
Female gender		60.5		54.1*
Patient morbidity indicators				
Length of stay		9.94 (15.26)		7.56* (11.96)
Propensity score		0.21 (0.139)		0.13* (0.087)
No. of conditions		1.36 (1.43)		1.29* (1.36)
Patient social factors				
Median income (zip code)		36375 (15617)		50666* (19622)
Insurance				
HMO	20.8		21.6*	
Self-pay	7.2		2.3*	
Medicare	3.1		46.4*	
Medicaid	21.9		4.6*	
Private	36.0		4.2*	
Medicare Supplemental	7.4		27.1*	
Nonemergent admission	59.0		45.3*	
Hospital characteristics				
Average daily census	464 (345)		390* (362)	
Utilization rate	74.6 (20.3)		74.2* (22.3)	
Hospital beds	632 (462)		512* (473)	
Herfindahl Index	0.10 (0.0180)		0.10 (0.019)	
For profit	1.9		2.0	
Teaching hospital	60.6		43.7*	
Hospital ecology				
Hospital (% black)	31.6 (24.04)		10.7* (9.3)	
Hospital (% Medicaid)	29.7 (17.05)		15.7* (10.6)	
Hospital median income	41769 (12168)		47513* (12662)	
Rural	0.8		7.2*	
Large MSA (>2.5 million)	85.3		55.6*	

*$P < 0.001$ (no other comparisons significant, $P > 0.05$). Any complications represents the presence of at least one of the postoperative complications.

DISCUSSION

Blacks have higher age- and sex-adjusted rates of surgical complications than whites in NYS. However, these disparities are largely explained by higher comorbidity and LOS among black patients. Further control for patient and hospital level characteristics fully explained racial disparity in surgical complications and injury. These results suggest that hospital factors contribute to racial disparities in surgical complications in NYS and suggest that such disparities are avoidable. The extent to which these findings apply to other states requires further study.

Previous studies have reported that blacks experience higher complications or worse outcomes following various surgical procedures.[2–8,18] However, findings have often been

TABLE 2. Odds Ratios by Race for Postoperative Complications by Clusters of Individual, Hospital Characteristic, and Hospital Ecologic Factors

Variable Cluster Adjusted for:	Adjusted Odds Ratio	95% Confidence Interval
Age/gender	1.65	1.51–1.81
Above + morbidity + LOS	1.19	1.09–1.31
Above + individual social factors	1.18	1.08–1.30
Above + hospital characteristics	1.09	0.99–1.20
Above + hospital ecological factors		
Quartiles of % black, or	1.06	0.98–1.16
Quartiles of % Medicaid, or	1.04	0.94–1.15
Hospital region (MSA), or	1.01	0.91–1.11
Quartiles of % median income	1.06	0.96–1.17

Each row summarizes a logistic regression odds ratio for race adjusted for variable cluster identified in left column.

confounded by unmeasured patient comorbidity and few studies have examined the role of hospital level factors. We used measures of surgical complications from AHRQ's patient safety indicators. Despite aggregating across 3 years of NYS data and across indicators to increase power to detect race-related effects, the effect of race was not significant after adjusting for morbidity and LOS and hospital characteristics. Similarly, no race effects were observed when each indicator was examined separately.

Our findings suggest that age- and sex-adjusted racial disparity in complications largely result from higher rates of comorbidity and LOS among blacks and secondarily from differences in hospitals used by blacks and whites. These findings suggest caution when inferring individual level discrimination based on disparities found using administrative data. They also highlight the need for improved understanding of differences in operative risk by race as well as racial patterns in hospital use.

Our findings are limited by use of hospital discharge data. Hospitals may differ in the extent to which they reliably code conditions present on admission and surgical complications. For example, it is possible that coding differs between teaching and nonteaching hospitals. However, unless such misclassification errors were associated with patient race, such error would not explain the dramatic change in odds ratio following adjustment. Furthermore, hospital discharge data do not include information regarding the severity of complications. It is possible that greater unmeasured disease severity among blacks obscured important disparities in complications. Furthermore, longer LOS may partly *result* from surgical complications. When it was excluded, race remained significant in the final model. These data do not include any information regarding quality, credentials, or level of education of the providers. Last, differences in level of supervision of surgical residents, longstanding restrictions on resident works hours, and state subsidies to hospitals serving indigent patients limit the generalizability of these findings from New York to other parts of the country.

CONCLUSION

Racial disparity in surgical complications in New York State are primarily explained by patient morbidity and LOS and secondarily by hospital characteristics.

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